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NRO REVIEW COMPLETED

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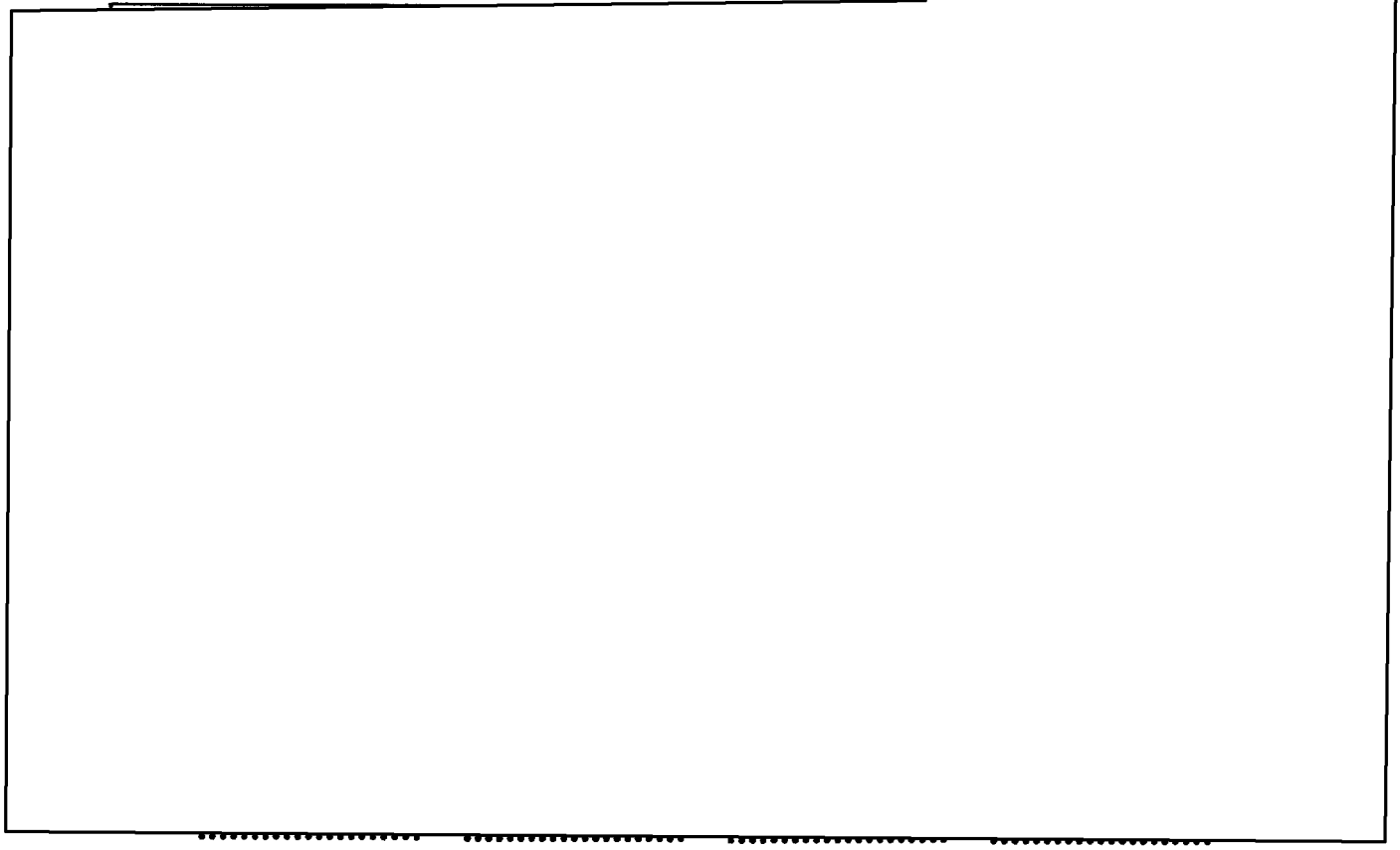

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Copy 5 of 12
7 June 1968

MEMORANDUM FOR: Distribution

SUBJECT : Adequacy of Bi-Color Exploitation Processes and Equipment

1. The attached memorandum written by a member of my office presents the current status of bi-color exploitation and a precise procedure for continuing with this endeavor. Hopefully, the information contained in this memorandum will be of interest and use to you in your efforts to develop a community-coordinated exploitation method and procedure.

2. Any questions should be directed [redacted] 25X1

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[redacted] 25X1

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7 June 1968

MEMORANDUM FOR THE RECORD

SUBJECT: Adequacy of Bi-Color Exploitation Processes and Equipment

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At the request [redacted] I have reviewed the procedures currently being used for the production of bi-color prints. This review culminated in a meeting that was held at NPIC on 5 June 1968. In attendance at the meeting were the following personnel:

[redacted] 25X1

The group was specifically constituted of the people who have been directly involved in the production of color prints, ACIC being responsible for the bulk of the orthoprinting and 25X1 [redacted] having accomplished the actual production of color prints 25X1 [redacted] A complete review of what we have done so far was made and several problems fully discussed. Perhaps the best way to summarize our findings is to report 1) what we have done so far, 2) new techniques that could be used, and 3) indicated action.

1.0 WORK TO DATE

The process used to date for the production of bi-color prints is shown schematically in Figure 1.

1.1 Specifics of the Process

The key step in this process is, of course, the orthoprinting. Because the red and green records are made

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[redacted]

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from individual cameras looking in different directions (i.e. FWD and AFT at a total stereo angle of 30°), it is necessary to remove both the distortions due to different look angles and those due to the panoramic camera itself. This can only be completely done on an orthoprinter. As has been demonstrated, this is the only way by which we can get adequate registration for color printing. The orthoprinter used to date is an AS-11C* which is an electronic device that "paints" the corrected image on the film by a line scanning technique. Because this is an electronic device, some enlargement from the original is necessary to maintain resolution. That is, the resolution of the AS-11C is such that the information retained if we orthoprinted from a contact print (or the original negative) would be extremely poor. Hence the requirement for at least a 10X enlargement. There are several problems with this process which will be discussed in Section 1.2.

The color printing was done [redacted] since NPIC was not yet trained in this procedure. A two-step color process was chosen (i.e. color negative to color positive) for production reasons. That is, making one superimposition of the orthoprints to produce one master color negative would allow the future production of any number of color positives without going again through the integration process. It is possible to produce a color positive directly from the orthoprints, but there is a "reorder" problem since the integration must then be done each time. 25X1

1.2 Problems with the Process

Several problems were isolated some of which, in retrospect, are controllable, some of which are not. We started by evaluating the bi-color prints that were produced [redacted] and comparing these with the prints made by the same process from mission [redacted] The comparison is dramatic, the [redacted] prints being of rather good quality and the [redacted] prints being, at best, poor. Color balance is off and detail is lacking. 25X1 25X1 25X1 25X1

* Work is currently underway trying the Unimace orthoprinter at AMS. 25X1

[redacted]

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25X1 The cause of the generally poor color balance of the [redacted] bi-color was fairly easy to track down and can be explained as follows.

As you can note from Figure 1, there are four photographic steps involved in the production of a final color print. It is very crucial that the tone reproduction of each stage be controlled very tightly due to the limited latitude of the color materials. If the contrast of each stage is not controlled, the final color print will be very poor; and this is what happened. As it is set up now, each stage of the photographic process increases the overall contrast of the picture. Starting out with a high contrast 10X enlargement and increasing its contrast at each step produces orthoprints of a contrast that the color materials cannot handle. For example, if the ON has a contrast of say 10:1, this can be increased to, say, 30:1 on the 10X positive. The orthoprinter will increase this to maybe 40:1. If, for my example, the color process can reproduce a contrast of only 15 or 20:1, significant information will be lost; and the colors will appear badly washed out in the highlight areas and very dark in the shadows. Depending on the severity of this situation, you can encroach on losing midtones as well.

This is not very easy to explain in writing, but in simplest terms the cause of poor reproduction of colors can be attributed primarily to the fact that the 10X enlargements were made at a contrast level that was much too high, and the total color process could simply not handle this contrast range. As you can see, this is not a fundamental problem and can be solved simply by making the enlargements at the proper contrast level. This problem was caused primarily by the "crash" nature of the
25X1 program. On the [redacted] test, we made several enlargements of varying contrasts and used the one that produced the best results. This imperical approach was not used during
25X1 the [redacted] production. In summary, then, significantly better color reproductions should be possible by more careful specification and control of the contrast of each stage of the bi-color production process.

The second major problem is more difficult to do anything about as it is fundamental to the AS-11C (and other electronic) orthoprinter(s). Simply stated, the 25X1

orthoprinter is introducing unwanted color shifts into the records. Since it is an electronic scanning device, the brightness of the scanning spot tends to change intensity. This is evidenced both locally (i.e. from point to point) and generally (i.e. a general drift in "nominal" spot brightness). This problem is, of course, characteristic of cathode ray tubes. In a descriptive sense, this problem appears as follows. In relatively small uniform areas (for example, a river), the spot to spot non-uniformity may be evidenced as a non-real color shift in the color of the river from say blue to red. This happens in an area of about 1/4 inch on the orthoprint. The general trend is evidenced in large areas. For example, a large patch of trees can go from green to blue. This effect evidences itself gradually over areas of 1 to 2 inches on the orthoprint. The effect ranges from giving a reddish cast to a bluish cast depending on whether the nominal intensity of the spot is increasing or decreasing. The severity of this problem is, I think, related to the target and what is of interest in that target.

The third major problem is, of course, the amount of area that can be orthoprinted. With a 10X enlargement, you get nominally a 3-mile X 3-mile area on the ground. For many applications, this is not a sufficient enough area. Larger areas can be done by using smaller enlargements (say 5X) but with an attendant loss in resolution. At present, there is no real way to solve this problem. Again, the severity of this as a problem is directly related to the target area and what it is one wants to see at various area coverages. If relatively low resolution is all that is needed to spot items for further detailed analysis (with a greater enlargement), then this technique may be acceptable.

2.0 IMPROVED TECHNIQUE

A new technique has been suggested by ACIC [redacted] 25X1
This technique eliminates many problems and appears to offer significant promise. The technique is shown schematically in Figure 2 and discussed below.

The new concept is based around using the [redacted] 25X1
25X1 [redacted] Orthophotoprinter. It does essentially the same job as the other orthoprinters except that it is an optical 25X1

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device as opposed to an electronic one. This means that the first immediate potential advantage is the elimination of scan lines and color shifts inherent with the electronic ortho-printers.

The one potential problem is that this equipment was never built to be used with panoramic photography. It was designed primarily for frame camera inputs. It appears, however, that it could handle a rectified pan camera input. Hence, as noted in Figure 2, we will have to rectify prior to 25X1 [redacted] This is no problem as rectification is a rather quick process (a whole pass can be done in about one hour) and several rectifiers are available at both ACIC and AMS.

An additional advantage [redacted] is that it will handle larger areas. We could, for example, handle an area on the original equivalent to about 10 miles (full width of the 70mm film) by 30 miles. The equipment also produces a larger orthoprint, enabling the final production (conceptually, at least) of bi-color prints 24 X 36 inches in size. The instrument also has some magnification capability of its own ranging up to about 5X. This means that if we went directly from the 25X1 rectified dupe [redacted] a 10X color print would result. Higher magnifications, for detailed analysis, are possible by simply making the appropriate enlargement from the rectified dupe and using that as the input [redacted]

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A last, but practical, consideration relative [redacted] 25X1 (if this technique works) is that it is more accessable. It is not, at present, in the production line at ACIC, as the orthoprinters are; and therefore we do not interfere with ACIC's normal job in using this equipment.

3.0 INDICATED ACTION

This leaves us with the question of what do we do to enable production of the best bi-color prints possible with available equipment. The problem of contrast control is identified and can be solved in further bi-color production. The question of which piece of equipment is best is hard to define. In addition, [redacted] has not yet been tried for this work. It was with this in mind that the aforementioned group proposed a test aimed at evaluating the three basic pieces of equipment to arrive at the best process for bi-color print

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production. I took the first step required to implement the test plan by sending a message to all concerned outlining what we needed to do and soliciting community support. Perhaps the best way to explain the plan, the participants, and the intent is to read the synopsis of the message sent which is attached as TAB A.

4.0 SUMMARY

In summary, we have made a fairly intensive review of current bi-color production procedures and equipment. Problems have been isolated, some of which can be easily resolved. The question of which equipment is best will be addressed in a test to be conducted and run by NPIC. It is anticipated that this test will be completed in six weeks. At present, the only reliable piece of bi-color exploitation equipment would appear to be the ARES, currently available at NPIC. Visual use of the ARES is recommended. It is expected that significant improvements can be made in the production of bi-color prints; however, the extent of the improvements will have to be assessed in the test program. 25X1

Attachment:
TAB A

djt

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